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Plant Tissues Suitable for Individual Selection of Mg in Tall Fescue

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Introduction:

Energy dispersive x-ray microanalyzer (EDX) is an efficient apparatus for forage screening. It can evaluate only a small amount of sample at a time. On the other hand, for screening forage mineral concentrations it requires that the sample is a representative of the whole plant for mineral concentrations. This study was conducted to identify the suitable tissue in selecting tall fescue populations for high Mg concentration by using EDX.

Materials and Methods:

A study with two tall fescue cultivars namely, HiMag and Ky-31 were conducted in Andosol of the Uwadai field of Iwate University, Japan. Pre-germinated seeds of these cultivars were grown in small plastic box containing vermiculite for 70 days. Then the seedlings were transplanted in field at May 9, 2001. About 100 plants of each cultivar were transplanted into a $6m^2$ plot containing two plants as a bunch. Ten plants from each cultivar were randomly selected for analysis. These plants were harvested at August 4, 2001 (First), and November 6, 2001 (Second). From each plant one representative tiller containing three leaves was selected for tissue analysis before harvest. An observation unit included several tissues centering around the vascular bundle, viz, epidermis, fiber, vascular bundle sheath (VBS), xylem, phloem and mesophyll. Magnesium (Mg), calcium (Ca), and potassium (K) densities in these tissues were determined by EDX. After fresh yield (6 cm cutting height) of each plant was determined, the sample was dried at 80℃ for 24 hours, and was ground. The concentrations of Mg, Ca, and K of these samples were determined by energy reflectance X-ray fluorescence (ERF).

Result and Discussion:

Mg densities of different tissues showed lower values in second harvest compared to that of first harvest (Table 1). Magnesium density in HiMag was ranged from 9.85% to 12.40% in first harvest while it was ranged from 7.01% to 9.64% in second harvest. In first harvest, tissues of HiMag was ranked as fiber>phloem>xylem>epidermis>mesophyll>VBS for Mg density. This can be arranged as epidermis>xylem>fiber>phloem>mesophyll>VBS in second harvest. Magnesium densities in xylem have consistent trend among the tissues across the harvests. In Ky-31, the Mg densities ranged from 5.94% to 7.93% in first harvest while 3.27% to 6.05% in second harvest. Potassium density in the tissues of HiMag was lowest in epidermis and xylem in first harvest while it was lowest in phloem in second harvest (Table 2). Calcium density in the tissues of HiMag was highest in phloem in first harvest while it was highest in epidermis in second harvest (Table 3). Plants having highest Mg density in xylem were selected among 20 plants. Frequency distribution of these top 10 plants is shown in Fig. 1. All these plants showed higher Mg concentrations across two harvests. These plants were also higher in Ca and lower in K concentrations.

Conclusion:

Plants selected according to the Mg density in xylem was representative of the high Mg containing plant. So, Mg density in xylem can be used for screening tall fescue plants.

Key words: Tall fescue, Tissue, Magnesium, Xylem, HiMag.

Table 1. Magnesium density in different tissues detected by EDX (%). *

Harvest	Cultivar	Epidermis	Fiber	VBS	Xylem	Phloem	Mesophyll
First	HiMag	10.28 a	12.40 a	9.85 a	10.74 a	11.47a	10.26 a
4-Aug, 2001	Ky-31	6.29 b	7.93 b	5.94 b	6.90 b	7.30 b	7.57 b
	(H-K)/K†	0.36	0.56	0.66	0.56	0.57	0.36
Second	HiMag	9.64 a	8.95 a	7.01 a	8.97 a	8.57 a	7.26 a
6-Nov, 2001	Ky-31	6.05 b	5.77 b	4.64 b	4.77 b	5.62 b	3.27 b
	(H-K)/K	0.59	0.55	0.51	0.88	0.53	1.22

*Values within column and harvests with the same letters are not significantly different at P<0.05.
† Variation of values between HiMag(H) and Ky-31(K).

Table 2. Potassium density in different tissues detected by EDX (%). *

Harvest	Cultivar	Epidermis	Fiber	VBS	Xylem	Phloem	Mesophyll
First	HiMag	35.30 b	39.40 b	40.96 b	35.32 b	36.37 b	45.24 b
4-Aug, 2001	Ky-31	47.4 4a	52.05 a	53.19 a	47.97 a	51.48 a	53.19 a
	(H-K)/K†	-0.26	-0.24	-0.23	-0.26	-0.29	-0.23
Second	HiMag	46.25 b	45.27 b	50.69 b	46.25 b	42.91 b	52.34 b
6-Nov, 2001	Ky-31	54.25 a	56.61 a	58.52 a	53.39 a	49.94 a	63.59 a
	(H-K)/K	-0.15	-0.20	-0.13	-0.13	-0.14	-0.18

*Values within column and harvests with the same letters are not significantly different at P<0.05.
†Same as Table 1.

Table 3. Calcium density in different tissues detected by EDX (%). *

Harvest	Cultivar	Epidermis	Fiber	VBS	Xylem	Phloem	Mesophyll
First	HiMag	14.06 a	13.62 a	13.18 a	11.03 a	15.60 a	12.71 a
4-Aug, 2001	Ky-31	7.97 b	7.07 b	8.01 b	7.68 b	9.63 b	7.83 b
	(H-K)/K†	0.76	0.93	0.64	0.44	0.62	0.62
Second	HiMag	14.24 a	8.96 a	9.55 a	10.67 a	12.52 a	9.08 a
6-Nov, 2001	Ky-31	11.68 b	7.66 b	8.32 b	9.61 b	11.94 a	7.07 b
	(H-K)/K	0.22	0.17	0.15	0.11	0.05	0.28

*Values within column and harvests with the same letters are not significantly different at P<0.05.
†Same as Table 1.

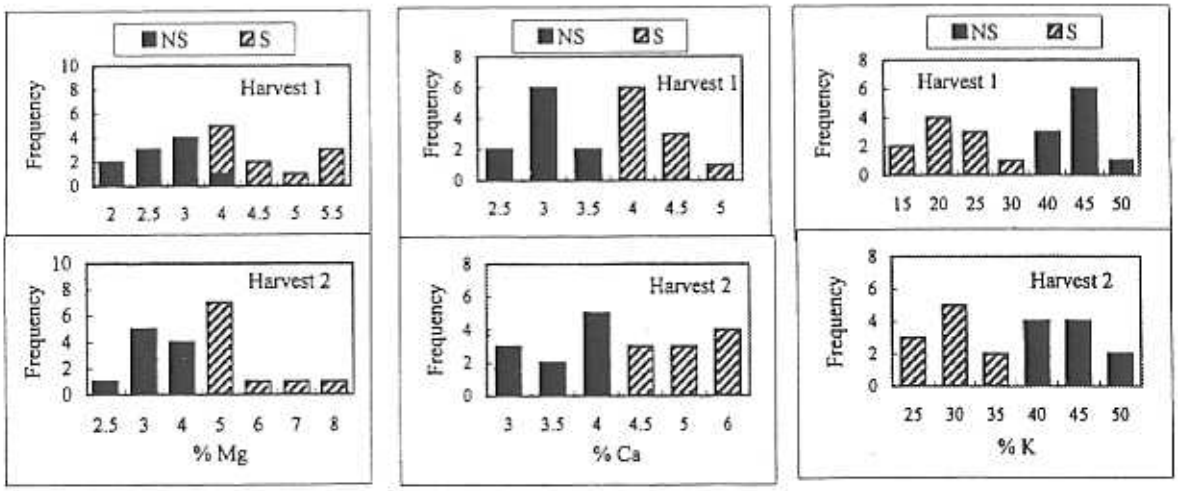

Fig. 1. Frequency distribution of top 10 plants selected according to zylem Mg density among 20 plants. NS: Non selected plants, S: Selected plants.